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Epizootic Situation of Parasitocenoses in Marals and Measures Aimed at Preventing and Treating Them in the Republic of Kazakhstan

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Abstract:
The epizootic situation of parasitocenoses in marals (Siberian red deer) and the species composition of helminths, protozoa and insects parasitizing on marals in the Republic of Kazakhstan were explored; their most frequently found aggregations were determined. A comparative effectiveness of various schemes of therapeutic and preventive measures was studied. The new antiparasitics, not previously used in marals, were tested. Insecticides were used to prevent infection of marals with botfly infestations and antler fly larvae. It is recommended to treat parasitocenosis of marals with broad-spectrum antiparasitics from the group of macrocyclic lactones and synthetic pyrethroids. A granulated feed mixture based on the Alvet antiparasitic was developed for the late chemoprophylaxis of parasitocenosis in marals.
Keywords: Helminthiasis in marals, botfly infestation, antler fly.

INTRODUCTION

Maral breeding is a dynamically developing high-yield and young livestock sector, which is of great importance in the economy of the Republic of Kazakhstan. The manufacture of antler products for the agribusiness is of strategic importance. The social and economic position of the majority of rural population depends on export earnings received from the sale of antler products. The East-Kazakhstan Region is the main producer and exporter of antler deer husbandry products in the Republic of Kazakhstan. Currently, 95 percent of the maral population is concentrated in the East-Kazakhstan Region. The natural and climatic zone of the region is the most favorable for the cultivation of marals. However, unfortunately, the current situation shows that the dynamics of growth in the number of marals and reindeer significantly deteriorates. Moreover, a significant decrease in the population is recorded in the homeland of these animals, in Katon-Karagai. Statistics shows that in the last 10–15 years, there has been a reduction in the number of marals and spotted deer as well as a decrease in their productivity [1].

The constant process of anthropogenic impact on marals for the purpose of domestication led to negative consequences. Marals' contacts with pets, a lack of natural selection, a high concentration of animals in pastures, and poor feeding contributed to the spread of over 50 different infectious and invasive diseases among marals. Along with helminthiases, marals are objects of parasitism of various parasitic insects, widely distributed in maral breeding farms of the Kazakh Altai [2; 3; 4].

More often, parasitic diseases occur in aggregations, as a result of which mortality (7–14%) and forced slaughter (3–7%) of animals are observed, antler production drops by 9–12% and animal yield decreases by 30–40%. The great economic damage from parasitocenosis is manifested through lagging in growth and development of deer as well as through the shortage in the antler weight increment. It also causes the rejection of affected organs during slaughter [5; 6].

The analysis of literature data has shown that Kazakhstan is on the way of struggling against certain types of parasitic diseases of marals [7; 8]. It has been scientifically proven that parasitic diseases of marals in monoinfestations also have a significant effect on the growth of livestock and the increase in productivity. However, with parasitocenosis, the course of the disease changes and assumes an idiosyncratical character. Associative diseases represent a serious scientific and production problem in animal husbandry [9; 10].

At present, a large arsenal of highly effective means is proposed for combating parasitocenosis, which makes it possible to solve the problem of combating parasitic diseases in a complex manner. Against the backdrop of long-continued use of drugs from the group of macrocyclic lactones, some parasites developed resistance to them, which regulates the search for new drugs and their application in scientifically justified terms. The task of science in this matter is to develop new and improve existing tools and methods for diagnosis and control of invasive diseases of marals [11; 12; 13]. In this regard, based on the knowledge about the biology of helminth development, the selectivity of drug acting and the epizootic situation in specific conditions, a comprehensive system of recreational activities for farms of the Katon-Karagai district is proposed.

MATERIALS AND METHODS

The experimental part of the work was carried out at the Parasitology Laboratory of the Shakarim State University and at maral breeding farms of the Republic of Kazakhstan.

A study of the parasitocenosis epizootology was carried out by researching the unfavorable maral farms during outbreaks and analyzing the statistical data from veterinary reports on the parasitic disease incidence of animals.

The species composition of parasitocenoses, their quantitative ratio and the dynamics of maral disease incidence were determined by the study of 1,871 samples of faecal masses. A coprological study of the collected samples was carried out by the flotation method according to G. A. Kotelnikov [14], by the method of Weid and Berman. The intravital diagnosis of dicroceliasis was carried out by the method of successive washing. The results obtained were processed statistically with the calculation of the average values of the number of eggs, helminth larvae in one gram of feces. A postmortem helminthological study was performed using K.I. Scriabin's method [15]. For differential diagnosis, the method of Strongylata larvae cultivation by A.M. Petrov and V.G. Gagarin (1953) was applied [16].

The intensity of infestations was determined from the results of helminthocoprological studies by counting eggs and oocysts in 20 microscope fields of view and helminthological autopsies. The extensiveness was determined by analyzing the data during copro-, ovo- and larvoscopy. The species of helminths and Eimeria were identified according to morphometric parameters using the determinants of Schultz, & Gvozdev [17]; Pryadko [2], Krylov [18]. Strongylata were determined to the species after cultivation of larvae, taking into account their morphology according to Polyakov [9].

In the course of the work, the systematics of helminths quoted in K.I. Skryabin's and coauthors' monographs [20] was adhered to.

Antlers were examined for being affected by the antler fly larvae after cutting in May–July. During the examination, the localization of the myiasis, the degree of lesion and the number of larvae were taken into account. A total of 257 antlers were examined, including 221 antlers of adult deer and 36 antlers of primiparous hinds. The need for such a subdivision is due to the fact that the antlers of primiparous hinds mature at the end of July with a high likelihood of being affected at this period by the antler fly larvae. The extensive and intensive indices of botfly infestations in marals (hypodermatosis and pharyngeal myiasis) were determined during the winter slaughter of animals (December, January) in the antler deer culled due to the low productivity and fatness that were not subjected to antiparasitic treatments.

The effectiveness of chemotherapeutic drugs was studied in spontaneously infested marals belonging to Aksu, LLP of the Katon-Karagai District. The following antiparasitics were field-tested: Ricazol (Ricobendazole); Sanofly (Cyfluthrin); Eprimec (Eprinomectin). A mixed fodder preparation based on the powdered Alvet (Albendazole) for the autumn chemotherapy of marals against parasitocenosis was prepared and tested. These drugs were experimentally and field tested during a spontaneous associative infestation of marals according to the general scheme.

For the chemoprophylaxis of botfly infestation and antler myiasis, marals were treated by spraying Sanofly thereon. The adult marals were sprayed from an automax since the beginning of the summer against antler flies and botflies. The intervals between treatments were 15 days. The consumption of insecticides per animal was 100 mL. When determining the effectiveness of treatments, the yield and quality of the antler products in the experimental and control groups were compared. The comparison was carried out after spraying the marals from the Verhkhatun experimental department. The antler products of marals from both groups were weighed and the average value was calculated [21].

According to the VNIIVEA method, the relative increase in productivity (E.%) and the saved productivity (SP, kg) were established according to the following formulas:

$$E = 100 \times (A2 \times B2) \div (A1 \times B2) \ (1);$$
$$SP = A2 - A1 \times B2 \div B1 \ (2)$$

where A_1 and A_2 were the productivity of the experimental group before and during the experiment period;

B_1 and B_2 were the productivity of the control group before and during the experiment period.

The Eprimec and Ricazol preparations were injected subcutaneously into the prescapular area in a dose of 3.0 mL per animal in accordance with the aseptic and antiseptic rules. Control animals (20 units) were not subjected to antiparasitic treatment. Before administering the preparation, the experimental and control animals were subjected to coprological examination. 30 days after dehelminthization, they were re-examined.

A single 12.0 g per animal dose of Alvet was given in a mixture. The mixture of fodder concentrate was prepared in a mini fodder plant of the "Agrotechnopark" research center of the Shakarim State University. A total of 20 adult maral stags were treated. The adult marals (17 units) standing next to them in the neighboring winter building served as control. Before applying the antiparasitic drug, after 30 days, biomaterial was taken from a part of the experimental and control animals and coprolarvoscopic studies were performed [22].

In order to achieve high effectiveness of application and exclusion of possible complications in animals (poisonings), it is necessary to pay special attention to the methods for proper preparation and use of solutions and emulsions of the drugs. Therefore, all drugs were used according to the available relevant instructions.

RESULTS AND DISCUSSION

The species composition of maral parasitocenosis in maral breeding farms of the Katon-Karagai District of the East Kazakhstan Region were determined through the methods of parasitological studies. Parasitizing of 19 helminth species was determined: 1 species of trematodes, 3 species of cestodes and 15 species of nematodes; 1 species of protozoa and 3 species of insects.

Out of 18 species of helminths found, there are 8 species of biohelminths, and 10 species of geohelminths. The results of animal autopsies show that a greater percentage of animals infested is determined in dicroceliasis (82.6%), and the lowest percentage is noted in moniesiasis (0.5–0.7%).

More helminths parasitize in the gastrointestinal tract (9 species), in the parenchymal organs (5 species), in the meninges (2 species), and in the subcutaneous tissue (2 species). The localization of individual parasite species revealed the following patterns: localization of Setaria was noted mainly in the abdominal cavity (up to 93.5%) with an intensity of 2–16 specimens, and only 6.5% of cases were localized on the meninges with an intensity of 1–4 specimens.

The accumulation of Ashworthia was noted to a greater extent in the abomasum (77.7% of cases), less often in the omasum and duodenum (22.3%). Trichocephalum was detected in the cecum (57.5%) and in the colon (42.5%). Verdicmansia were more common in the body adipose layer (89.7%) than in the limbs (10.3%), while the intensity of the infestation was 2–16 and 1–3 verdicmansiosis nodes, respectively.

The epizootological study was carried out in the low-mountain (Abzal farm), middle-mountain (Maraldy farm) and mountain (Aksu, LLP) zones of the region. According to the data of coprological studies, the average prevalence of infestation (PI) in the low-mountain zone in elaphostrongylosis was 40.7% with an infesting intensity (II) of 14.3 specimens/g; in dictyocauliasis –18.3% with II of 15.8 specimens/g; in dicroceliasis – 40.25 with II of 13.1 specimens/g; and in gastrointestinal strongylatosis– 22.4% with II of 4.3 specimens/g. In the middle-mountain zone, the prevalence of infestation in elaphostrongylosis was 55.8% on average in the zone with an II of 39.8 specimens/g; in dictyocauliasis – 19.2% with II of 16.1 specimens/g; in gastrointestinal strongylatosis– 25.8% with II of 6.3 specimens/g, and in dicroceliasis – 51.0% with II of 14.4 specimens/g. In the mountain zone, the prevalence of infestation in elaphostrongylosis was 46.9% with an II of 24.3 specimens/g; in dictyocauliasis – 22.5% with II of 16.2 specimens/g; in gastrointestinal strongylatosis– 31.0% with II of 4.7 specimens/g; and in dicroceliasis –18.4% with II of 6.4 specimens/g. Elaphostrongylosis and dicroceliasis were more prevalent in the middle-mountain zone (55.8% and 51.0%, respectively), and dictyocauliasis and gastrointestinal strongylatosis prevailed in the mountain zone (22.5% and 31.0%, respectively) (Table 1).

In the age aspect, the prevalence of Setaria infestation ranges from 26.3 to 56.3% with II of 4.6–10.8 specimens; in elaphostrongylosis, respectively, PI is from 32.5 to 86.9% with II of 5.0 to 24.6 specimens; in dictyocauliasis, PI is from 24.1 to 41.5% with II of 4.4 to 32.8 specimens; in varestrongylosis, PI is from 25.7 to 41.2% with II of 3.9 to 42.5 specimens; in dicroceliasis, PI is from 30.7 to 68.1% with II of 32.2 to 145.6 specimens; in verdicmansiosis, PI is from 10.0 to 53.7% with II of 2.0 to 7.8 specimens; in intestinal Strongylata, PI is from 32.5 to 82.3% with II of 10.6 to 147.2 specimens (Table 2).

With the exception of verdicmansiosis and intestinal Strongylata, the maximum extensive and intensive indicators for the other helminths were found in young deer. This sex-age group was the most affected by helminthiasis. Among adult animals, with the exception of intestinal nematodosis, maral stags had large extensive and intensive rates of infestation in comparison with maral hinds. Besides, they were more infested by Dicrocoelium than any other sex and age groups. In baby marals a similar situation was observed in terms of intestinal nematodosis (147.2 specimens per animal).

Table 1. The epizootic situation of parasitic diseases in maral breeding farms of the East-Kazakhstan Region

Name of farms	Elaphostrongylosis		Dictyocauliasis		Dicroceliasis		Intestinal strongylatosis	
	PI, %	II, specimens	PI, %	II, specimens	PI, %	II, specimens	PI, %	II, specimens
Abzal Farm	40.7	14.3	18.3	15.8	40.25	13.1	22.4	4.3
Maraldy Farm	55.8	39.8	19.2	16.1	51.0	14.4	25.8	6.3
Aksu, LLP	46.9	24.3	22.5	16.2	18.4	6.4	31.0	4.7

Table 2. Extensive and intensive indicators of helminthic infestation of marals in the sex and age aspects

Type of helminthiasis	Extensive (%) and intensive (specimen) indicators of infestation by age and sex groups							
	Adult stags		Hinds		Young deer		Baby marals	
	PI	II	PI	II	PI	II	PI	II
Infestation by Setaria	40.0	4.6 ± 0.1	26.3	6.2 ± 0.2	56.3	10.8 ± 3.3	44.8	4.8 ± 0.4
Elaphostrongylosis	62.1	24.6 ± 0.6	32.5	6.9 ± 0.4	86.9	16.5 ± 1.3	50.9	5.0 ± 0.1
Dictyocauliasis	33.8	32.8 ± 1.3	24.1	11.3 ± 1.2	41.5	14.2 ± 1.4	41.0	4.4 ± 0.1
Varestrongylosis	27.8	15.1 ± 1.1	25.7	42.5 ± 2.3	41.2	13.8 ± 1.2	27.3	3.9 ± 0.1
Dicroceliasis	57.4	145.6 ± 10.4	56.5	47.7 ± 2.7	68.1	32.6 ± 3.6	30.7	32.2 ± 3.3
Verdicmansiosis	53.7	5.7 ± 0.5	34.3	7.8 ± 0.4	37.6	6.6 ± 0.2	10.0	2.0 ± 0.1
Intestinal nematodosis	32.5	10.6 ± 0.2	46.3	15.2 ± 1.4	77.1	34.4 ± 3.4	82.3	147.2 ± 6.6

Table 3. Infestation of marals with myiasis

Maral Breeding farms	Booponuosis		Hypodermatosis		Pharyngeal myiasis	
	PI, %	II, specimens	PI, %	II, specimens	PI, %	II, specimens
Aksu, LLP	11.3	14.0 ± 1.6	32.2	10.7 ± 2.1	40.65	5.9 ± 0.2
Abzal Farm	14.6	17.5 ± 0.8	36.1	13.15 ± 0.6	46.15	7.5 ± 0.7
Maraldy Farm	12.8	16.2 ± 1.4	35.2	12.75 ± 1.3	44.9	6.4 ± 0.1
Average values of PI and II	12.9	15.9 ± 0.6	34.5	12.2 ± 1.7	43.9	6.6 ± 0.3

Maral hinds and baby marals were less infected with helminths, as compared to young deer and adult stags, because of their reserved manner of grazing after the birth of calves (early in the morning and late at night), which protected them from attacks of bloodsucking flies. In addition, during the summer-autumn pasture period, they were not disturbed. They were evenly distributed in the park without overcrowding. As a rule, forested remote gardens with good herbage were allocated to them, which prevented infestation with geo-and biohelminths. Baby marals, with the exception of intestinal nematodosis, were less infested with helminthiases, as compared to other sex and age groups, which was associated with the character of nutrition. After the birth and before ablactation, the main food for them was milk. Therefore, since the main transmission factors for helminthiases were pasture grass and water, they might be infested during a later period (in autumn).

Maral stags were more infested with geo-and biohelminths, as compared to hinds, because of specific behavior during the rutting time, on the one hand, and their more intensive crowding on limited pasture areas during the cutting of antlers, on the other hand.

The most common helminthiases in maral breeding farms were dicroceliasis, strongylatosis and trichocephalosis. When examining marals on parasitocenosis, an aggregation was recorded in all animals. The parasitization of Elaphostrongylus and Dicrocoelium was most often noted in 19.1% of cases; Dicrocoelium and Ashworthia – in 5.1%; Elaphostrongylus, Dicrocoelium and Verdicmansia – in 3.9%. The remaining aggregations were found in isolated cases, which made from 0.6% to 3.3%. There were 6 aggregations common to all sex-age groups under study: 1) Elaphostrongylus + Dicrocoelium; 2) Elaphostrongylus + Dicrocoelium + Verdicmansia; 3) Elaphostrongylus + Dicrocoelium + Ashworthia; 4) Elaphostrongylus + Setaria + Dicrocoelium; 5) Setaria + Dicrocoelium; and 6) Dicrocoelium + Ashworthia.

The infestation of marals by intestinal strongylatosis and dictyocauliasis in farms of the region did not exceed 10–24%, while the intensity of infestation was at the level of 2.8–24.6 specimens/animal unit. The issue of elaphostrongylosis was still acute. Depending on the age and sex group and the study time, the prevalence of infestation was 18–100% with an intensity of 12 to 70 or more larvae/sample.

Features of the epizootology of maral entomosis were studied according to the epizootic survey of such maral farms as Aksu, LLP, Angu-Abzal, LLP, and Maraldy Farm in the Katon-Karagai District of the East Kazakhstan Region.

Analyzing the PI data in booponuosis, 11.3% were registered at Aksu, LLP, 14.6% – at the Abzal Farm, and 12.8% – at the Maraldy Farm with II of 14.0 ± 1.6, 17.5 ± 0.8, 16.2 ± 1.4 specimens of larvae, respectively. An average PI value by regions reached 12.9% with II of 15.9 ± 0.6 specimens of larvae (Table 3).

An average PI value of hypodermatosis was 34.5% with II of 12.2 ± 1.7 specimens of larvae. By districts, these indicators of prevalence ranged from 32.2% in Aksu, LLP, to 36.1% in Abzal Farm and 35.2% in Maraldy Farm with the intensity rate of 10.7 ± 2.1, 13.15 ± 0.6 and 12.75 ± 1.3 specimens of larvae, respectively. Infestation of marals with larvae of the nasopharyngeal botfly was somewhat higher in comparison with the warble flies. The average value of infestation prevalence was 43.9% with II of 6.6 ± 0.3 specimens. These indicators by districts were not unambiguous and reached 40.65% in Aksu LLP, 46.15% in Abzal Farm, and 44.9% in Maraldy Farm with II of 5.9 ± 0.2; 7.5 ± 0.7; 6.4 ± 0.1 specimens of larvae, respectively.

Associative development (parasitocenosis) of hypodermatosis and pharyngeal myiasis was diagnosed in 38% of adult stags, 42% of hinds, 63% of young deer, and 26% of baby marals.

In the entomosis of antler deer, hypodermatosis (34.5% of PI) and pharyngeal myiasis (43.9% of PI) featured the prevalent distribution. The spread of booponuosis directly correlated with the anthropogenic impact on the population of antler flies. Therefore, PI (12.9%) featured less natural distribution.

The recorded difference in the prevalence and intensity of infestation of both helminthiasis and entomosis in the context of districts and the republic is due to the quality of veterinary and preventive measures carried out in farms and conditions of maral maintenance.

A degree of helminthiasis spread depends on the natural and climatic conditions within the location of a nursery for marals, the density of maral population, the veterinary and sanitary state of a maral farm, the regularity and quality of antiparasitic treatments, and the quality of anthelminthics used. These factors are ambiguous by maral farms. Therefore, the epizootic situation also differs.

In connection with an increase in the density of marals per a unit of pasture, the contact of marals in parks with domestic farm animals promoted the spread of parasitocenosis among them, as compared to their wild relatives.

It can be noted that simultaneous infestation with several species of parasites (from 2 to 6) was recorded in 26.5% of the infested animals. The comembers of the parasitocenosis were the Strongylata of the digestive tract, Dicrocoelium, Trichocephalus, Eimeria, Dictyocaulus, and larval Echinococcus. The main components of the parasitocenosis composition were mainly the Dicrocoelium.

A joint development of dicroceliasis, elaphostrongylosis, and verdicmansiosis in aggregations of parasitocenosis is not a simple mechanical addition of helminths, but a dynamic disease with a sharp gastrointestinal disturbance, adverse respiratory effect, high body temperature, and intestinal enzymes' disorder.

A pathogenic influence of helminths in parasitocenosis of marals is aggravated by protozoa. An average incidence of marals is indicated by eimeriosis (8.3%), which progresses in various aggregations with esophagastomosis, dicroceliasis, and trichocephalosis. Such combinations in parasitocenosis of marals cause not only a strong disease with a loss of productive qualities, but also the death of animals.

The extensive and intensive efficiency of antiparasitics were not determined specifically for some form of invasion disease in antler deer (which is very rare in marals). Their effectiveness precisely in the aggregative infestation was determined, which defined the name of the broad-spectrum drugs.

The results of the carried out experiments and field tests of preparations from the group of macrocyclic lactones and synthetic pyrethroids in antler deer have shown that they all possess a pronounced activity against botfly infestations and helminthiases. It is well known that parenteral administration of anthelmintics is more effective than oral administration. Eprimec was the most effective antiparasitic among the tested drugs of early chemotherapy. 20 maral stags from two neighboring winter houses were tested. Conditions for maintenance and feeding of both groups were identical and corresponded to those typical for the given farm.

Before the experiment began, a biomaterial for coproscopy examinations was taken from 15 animals of each group. According to their data (Table 4), the prevalence of aggregative infestation in both groups was practically the same with the intensity of 83.0 ± 9.4 specimens according to the data of ovoscopy, and 108.0 ± 7.2 specimens according to larvoscopy. The larvae of elaphostrongylus, dictyocaulus, and eggs of intestinal Strongylata were identified.

In general, spraying the pelage and skin coat of animals with a dose of 100 mL per animal in the form of 0.02% water emulsion of Sanofly is an effective way to protect marals from attacks of nasopharyngeal and subcutaneous botflies, zoophilic flies and nematodes (gadflies, midges, mosquitoes, and black gnats). In the conditions of summer pastures, the residual effect of the drug is preserved up to 28 days, which makes it possible to protect marals from attack of nasopharyngeal and subcutaneous botflies, zoophilic flies and gnatosis as well as to prevent pharyngeal myiasis and hypodermatosis among marals.

In view of the poor taming of marals, special conditions of their breeding, their biological rhythms and the nature of production, preventive and therapeutic measures in maral farms are possible only at certain times of the year.

Marals are bred in the conditions close to the natural habitat (fenced wooded, mountain pastures with 1.5–2.0 hectares per animal). Over the 150-year history of domestication, they have not become obedient agricultural animals. They are characterized by a wild temper, herd instinct, and seasonal biological rhythms. Consequently, when developing schemes of therapeutic and preventive measures against parasitocenosis of marals, it is necessary to mind not only the biological cycles of parasites, determining optimal treatment times, but also the above-mentioned features.

Given the above facts, the treatment of marals is possible only after fixing them on an antler cutting machine. Sanofly, due to a long residual effect, can be introduced into production as part of a complex of summer prophylactic treatments of marals to regulate the number of zoophilic flies and blood-sucking dipterous insects. These measures can be carried out during the mass summer of parasitic insects in June–August with an interval of 21–28 days. At the same time, it must be remembered that chemoprophylaxis should be used no more than 3–4 times per season, since repeated use of several drugs adversely affects the health of animals.

Table 4. Efficiency of Eprimec under the experimental conditions

Group of maral s	Number of animals in the group	Examined before Treatment			Examined after treatment		
		animal units	PI, %	II, larvae	animal units	PI, %	II, larvae
Experimental	20	15	86.6	108 ± 7.2	15	13.3	4 ± 1.3
Control	20	15	83.2	111 ± 6.7	15	86.6	116 ± 3.8

Table 5. The effectiveness of Sanofly for the protection of marals from botflies, zoophilic flies and gnatosis

Group of marals	Years		Changes in the weight of antlers, kg	Comparative increase in antler products, %	Preserved productivity, kg
	2016	2017			
Control	5.49 ± 0.44	6.08 ± 0.27	0.59	11.5	0.57
Experimental	5.54 ± 0.08	5.47 ± 0.31	-0.07	-	-

As can be seen in Table 5, the proposed dose of the insecticide proved to be very effective against ectoparasites and made it possible to increase the antler productivity by 11.5%.

The prevention and treatment of maral parasitocenosis is a complex of measures that requires from veterinary specialists the correct and precise organization of all antiparasitic activities. To ensure the well-being of marals by parasitocenosis, it is necessary to conduct a complex of organizational, economic, therapeutic, preventive and veterinary-sanitary antiparasitic measures.

In the fight against parasitocenosis of marals, a set of measures should be applied, consisting of measures that prevent the disease and, in case of occurrence, provide timely treatment of sick animals.

CONCLUSION

The high rates of the maral industry development, and a large number of newly organized farms created certain difficulties in the organization of veterinary services, which adversely affects the well-being in respect of infestation diseases in antler deer. The introduction of the developed complex system of control and prevention measures, consisting of rational schemes for diagnosis, prevention and treatment, into the veterinary practice of maral farms will accelerate the diagnosis of aggregative parasitic diseases, increase the effectiveness of therapeutic and preventive measures, and reduce the morbidity and mortality of marals. Therefore, the development and implementation of complex measures for the prevention and therapy of parasitocenosis will certainly lead to the stabilization of maral population, the increase in the productivity and quality of raw materials, the provision of the epizootic well-being of maral farms, and, respectively, to the socio-economic revival of the region.

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